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How to Root and Graft Slash Pine

by François Mergen and Harry Rossoll



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U. S. Department of Agriculture - Forest Service



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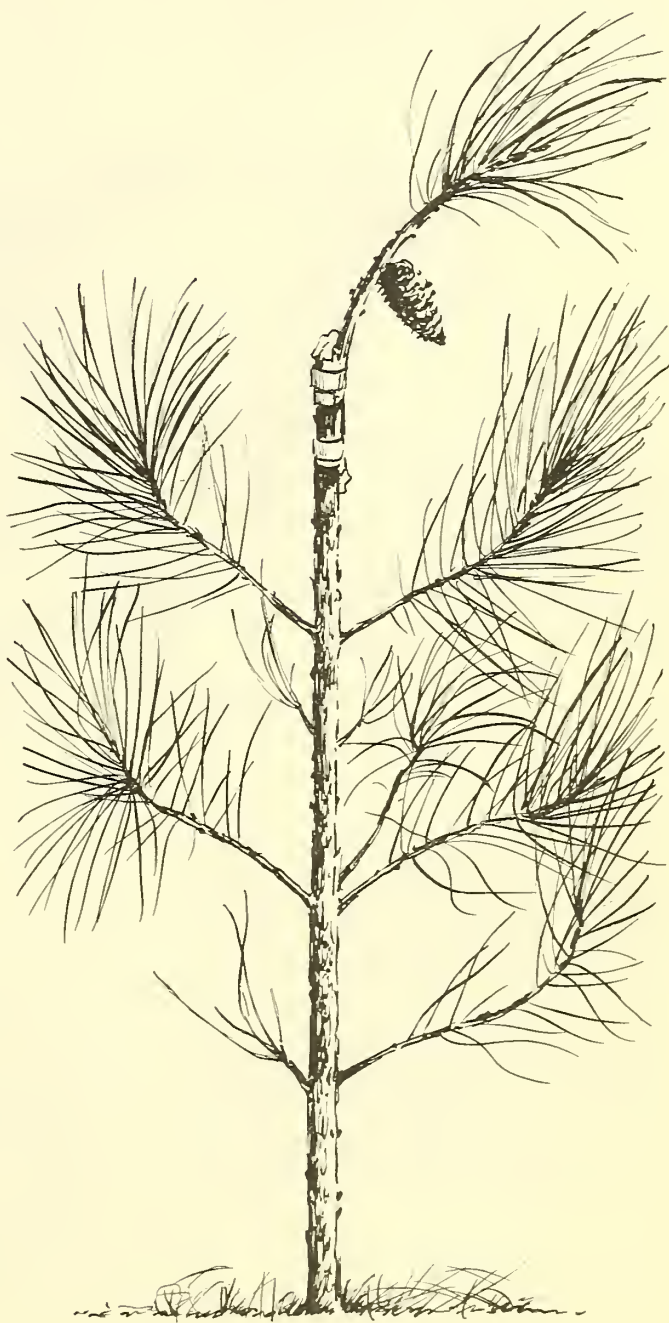
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INTRODUCTION

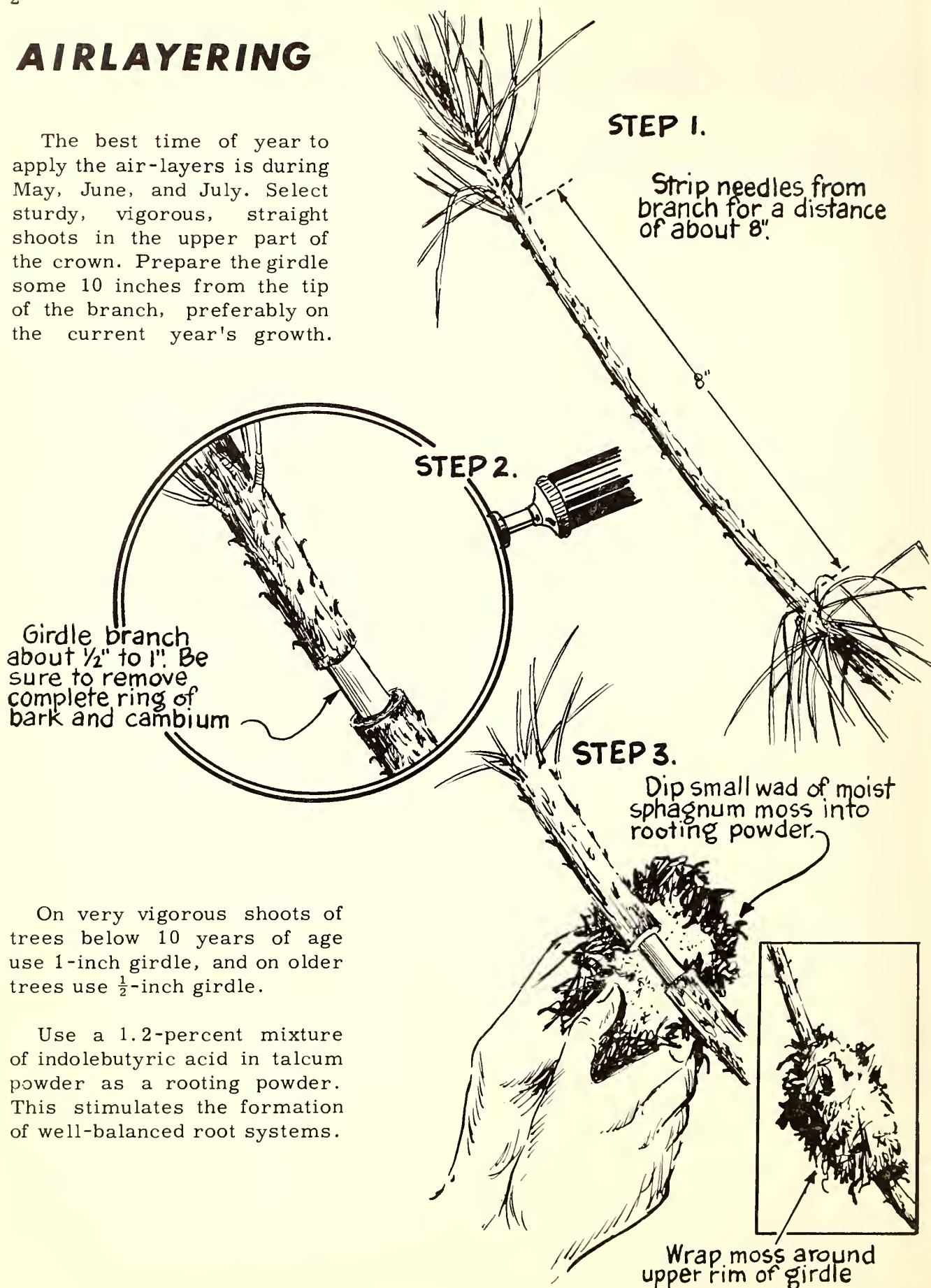
Various industrial foresters and others not actively engaged in detailed research in the field of forest tree improvement frequently need specific instructions on the vegetative propagation of slash pine. In this outline, various steps for vegetative propagation are described in detail, including methods for air-layering, grafting with succulent and dormant material, and inarching seedlings into the crowns of mature trees.

All methods described in this report have been tested by the senior author and are being used successfully in the forest tree improvement program at Lake City.



AIRLAYERING

The best time of year to apply the air-layers is during May, June, and July. Select sturdy, vigorous, straight shoots in the upper part of the crown. Prepare the girdle some 10 inches from the tip of the branch, preferably on the current year's growth.



On very vigorous shoots of trees below 10 years of age use 1-inch girdle, and on older trees use $\frac{1}{2}$ -inch girdle.

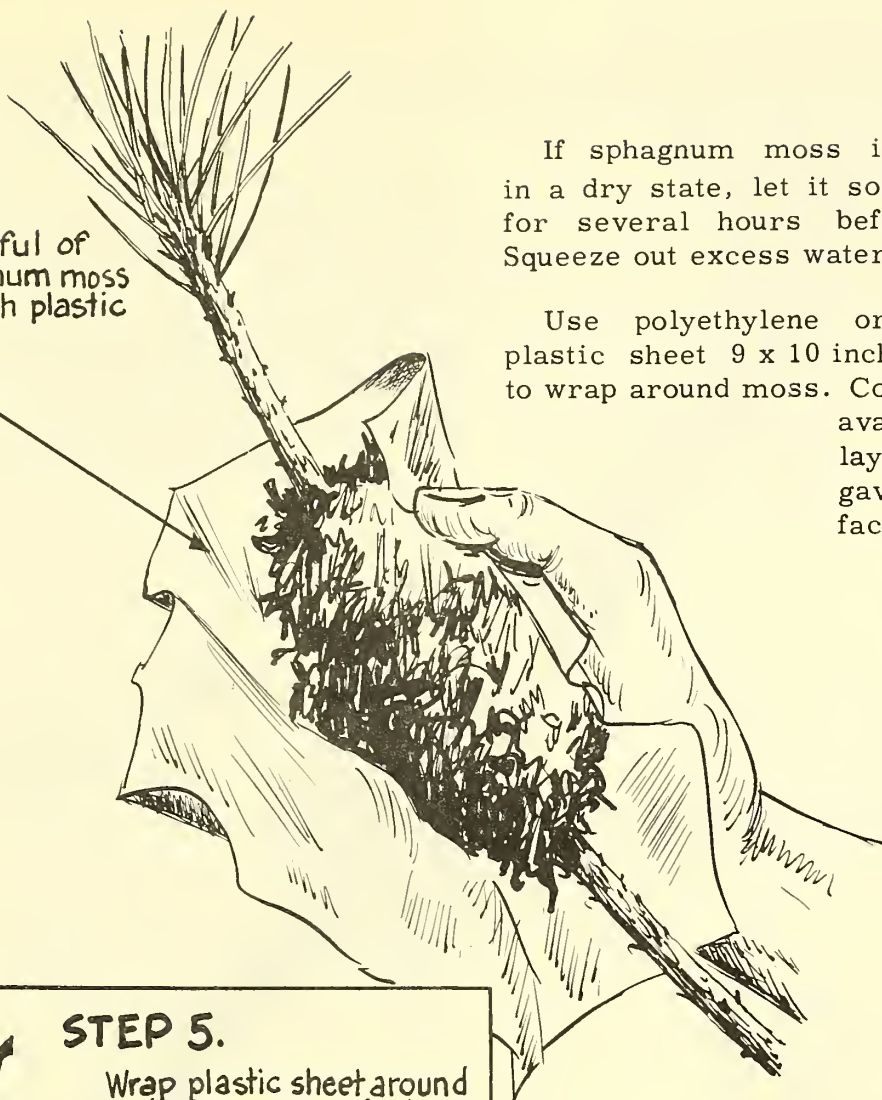
Use a 1.2-percent mixture of indolebutyric acid in talcum powder as a rooting powder. This stimulates the formation of well-balanced root systems.

STEP 4.

Add a handful of moist sphagnum moss and cover with plastic sheet.

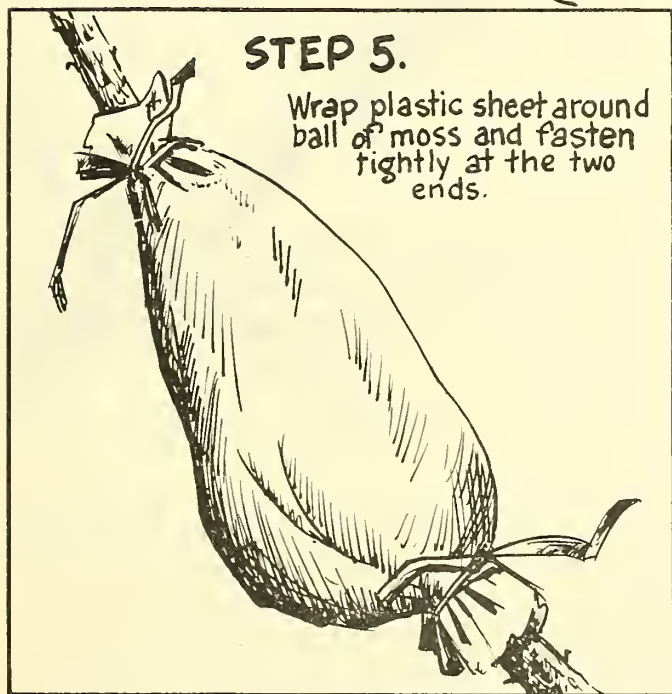
If sphagnum moss is collected in a dry state, let it soak in water for several hours before using. Squeeze out excess water.

Use polyethylene or polyvinyl plastic sheet 9 x 10 inches in size to wrap around moss. Commercially available air-layering sheets gave very satisfactory results.

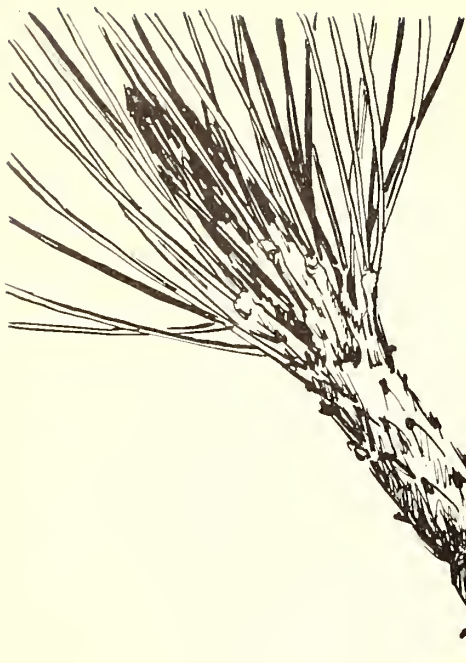


STEP 5.

Wrap plastic sheet around ball of moss and fasten tightly at the two ends.



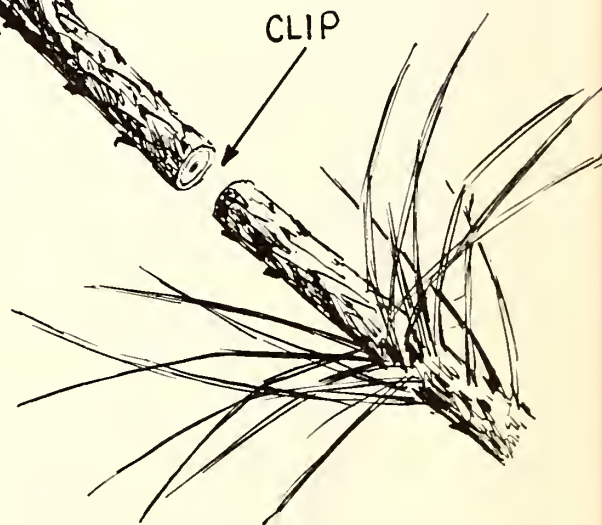
Cover the sphagnum moss completely and be sure that no opening is left for the evaporation of moisture from the moss. If properly applied, the moss will stay moist for several months. When drying becomes noticeable, add water with a hypodermic syringe.



Roots form within 6 to 8 weeks but branch should be left on tree for at least 12 weeks so that roots become firmer and develop side branches. The white root tips will become visible through the plastic wrapping. When branch is cut off, don't remove the sphagnum moss and don't disturb the root system.

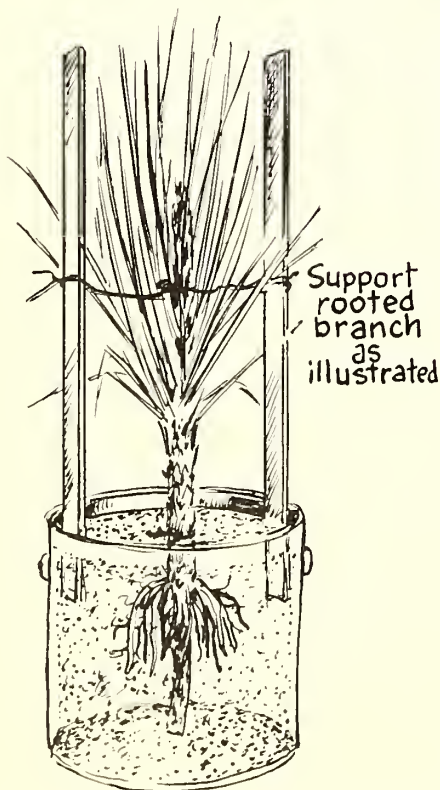
STEP 6.

After roots have formed clip off branch about 4" to 5" below girdle



STEP 7.

Plant in loose soil and keep in shade. WATER WELL



A mixture of sand, vermiculite, and peat in equal parts was found very suitable as a potting medium. Fertilizing the rooted branch with a soluble fertilizer stimulates root growth. Potted plants can be outplanted into the field after roots are well developed.

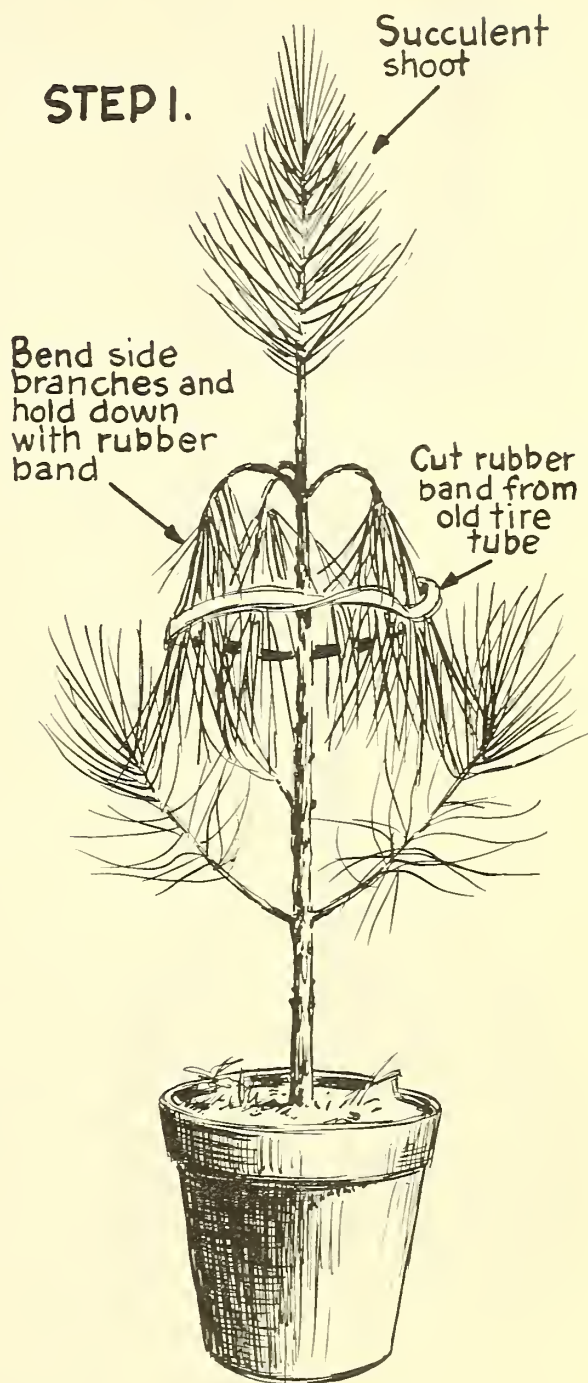
GRAFTING WITH SUCCULENT TISSUE (Cleft Graft)

A large percentage of successful unions is obtained when stock and scion are in a succulent condition. The method described is suitable for grafting directly on stock growing in the field, or for potted plants in a lathhouse, or greenhouse. The best time to graft with succulent material is during the later part of April, May, June, or early part of July. Grafting can be started as soon as the leader has added several inches of new growth, even though not all the needles of the new growth have ruptured the sheath.

As in any type of grafting, the outcome greatly depends upon the condition of the stock. Use only trees as understock which are healthy and in a vigorous growing condition. When potted plants are used, best results will be obtained if they have been in the container for at least six months prior to being used. Trees 1 to 3 years old make good understocks. For best results select a stock plant with diameter at the place of grafting the same as that of the scion.

The grafting knives and clippers need to be very sharp and kept in good condition during the entire grafting work. Wipe blade of knife frequently with a wad of cotton soaked in alcohol to remove gum (oleo-resin). A clean sharp knife will slice the cells instead of tearing the tissue.

If grafting is done on potted stock, place the grafting bench in the shade.

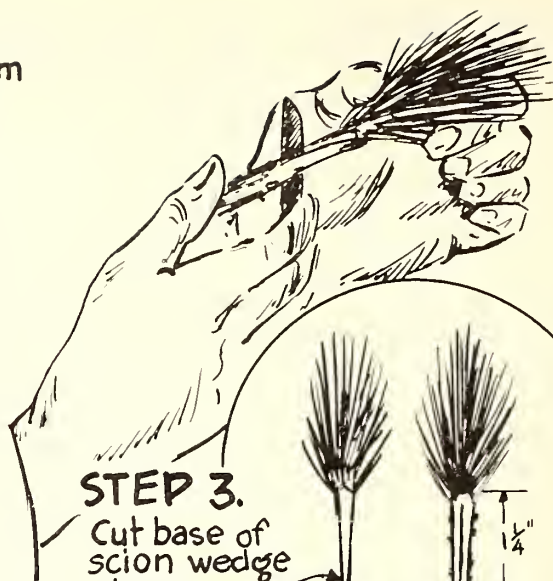
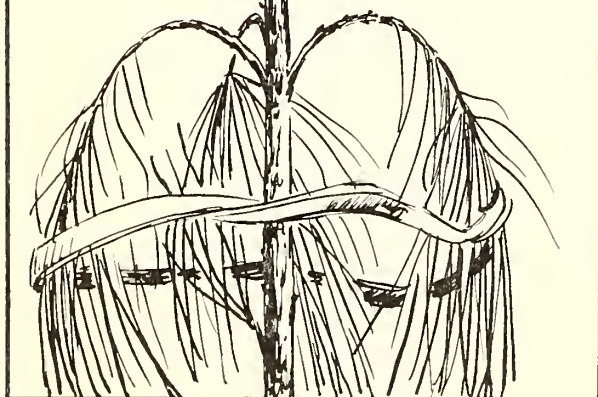
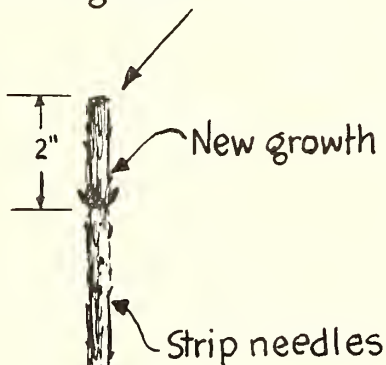


STEP 2.

Succulent scion from
SELECTED TREE



Clip off top leaving 2" of
succulent growth

**STEP 3.**

Cut base of
scion wedge
shape

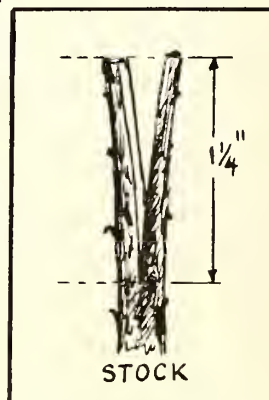
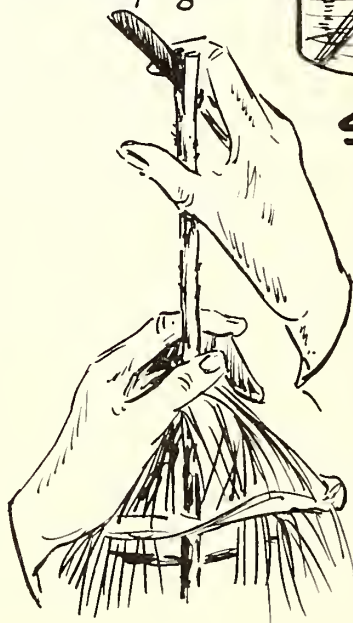
Put scion in glass
of water to pre-
vent drying out



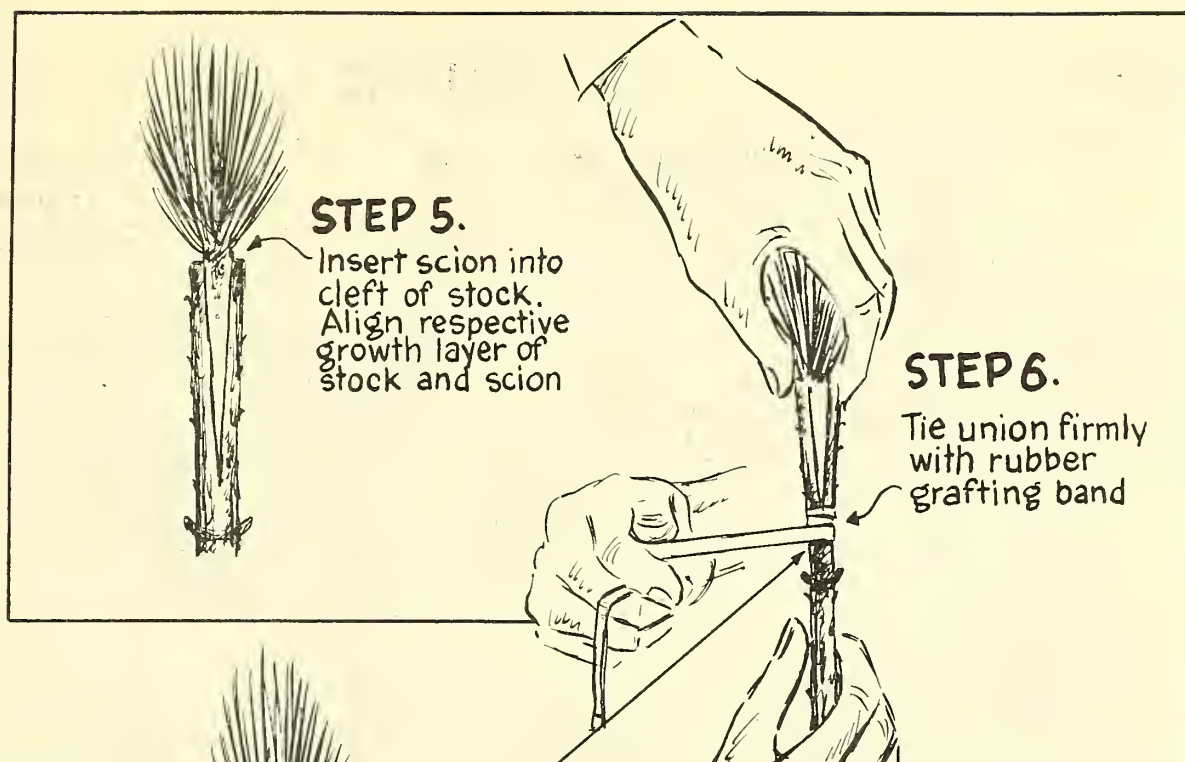
Cut square

STEP 4.

Make vertical cut
into new growth
of stock

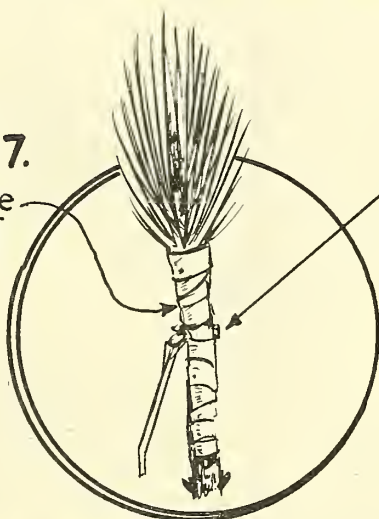


Collect the scions from the outer edges of the crown. Use only the succulent growth from the current year, as the scion need only be 2 to 3 inches long. Freshly collected material will be best and should be kept cool and moist until used. For field collection, a pail filled with clean water, or a plastic bag, have been found satisfactory. Prevent heating up of the scions. Do not use scions which become covered with mold.



STEP 7.

Complete binding and tie



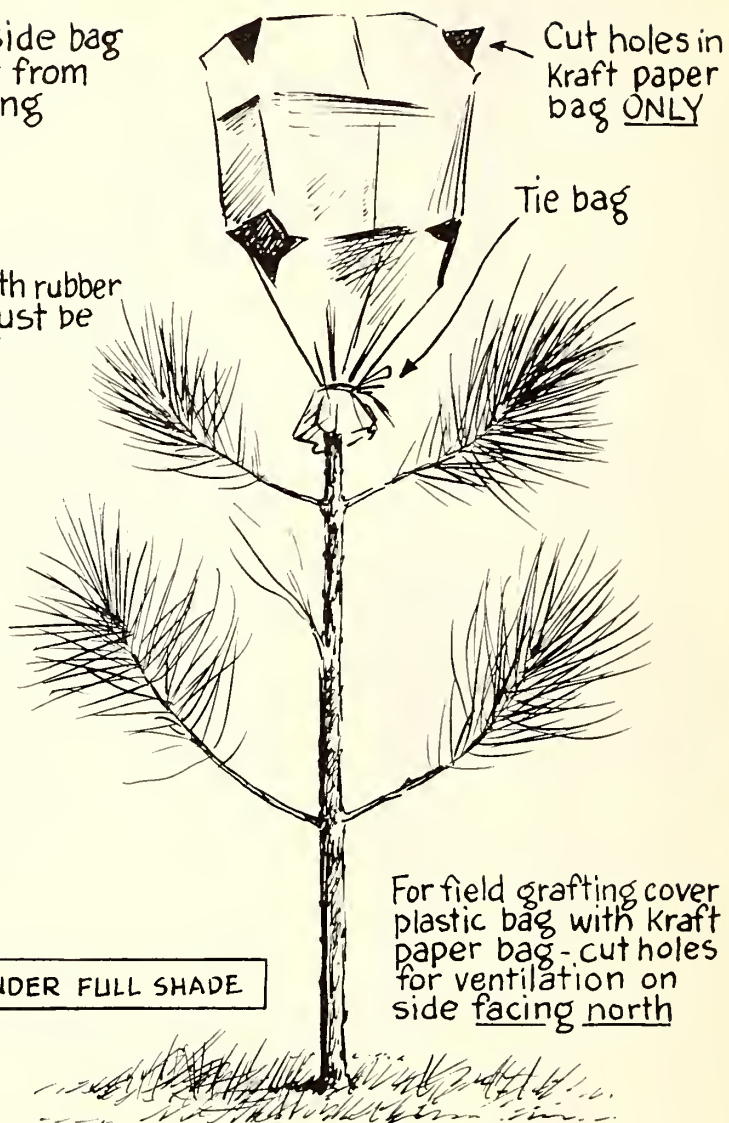
Align and fit scion into cleft on stock properly and promptly. Delay will cause desiccation of the wound surfaces, and the proper alignment decreases the distance between the graft partners which has to be bridged.

Apply the binding evenly along the full length of the union to prevent the formation of resin pockets between the cut surfaces. Also, when the contacting surfaces are uneven and not under pressure, air-filled clefts form between stock and scion. The correct binding, and the application of an even pressure along the full length of the cuts, is of great importance during the knitting of the union.

STEP 9.



STEP 10.



Polyethylene plastic bags of various sizes can be purchased in hardware stores. They are sold as packaging material for deep-freezers.

If convenient, the new whorl of branches being formed below the graft can be enclosed also within the bag. Keep the bags over the grafts for 4 to 8 weeks, depending on the weather. Remove bags gradually by first loosening the binding of the bag and letting outside air into the bag for a couple of days. After bag has been removed completely, cut grafting rubber as indicated on page 18.

Union of Scion and Stock 18

Months after Grafting



If slash pines are grafted at a time when the tissues of both stock and scion are succulent, the union becomes very firm as illustrated by the photograph of the tangential cuts through two graft unions. Also, when the cells along the grafting cuts are still in an active stage of differentiation and little lignification has occurred, the knitting of the union is rapid and large numbers of successful grafts are obtained. The above photograph was taken 18 months after grafting. On most plants the union between scion and stock was hardly discernible on the outer bark.

GRAFTING WITH DORMANT SCION (Bottle Graft)

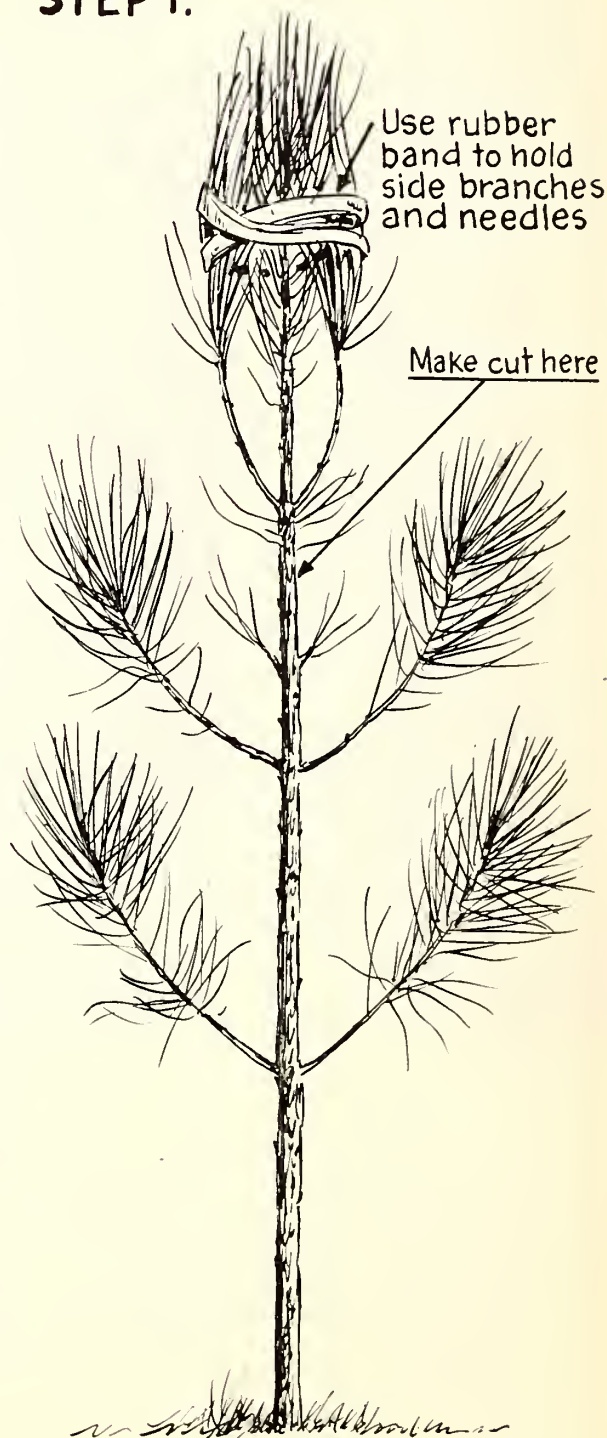
STEP 1.

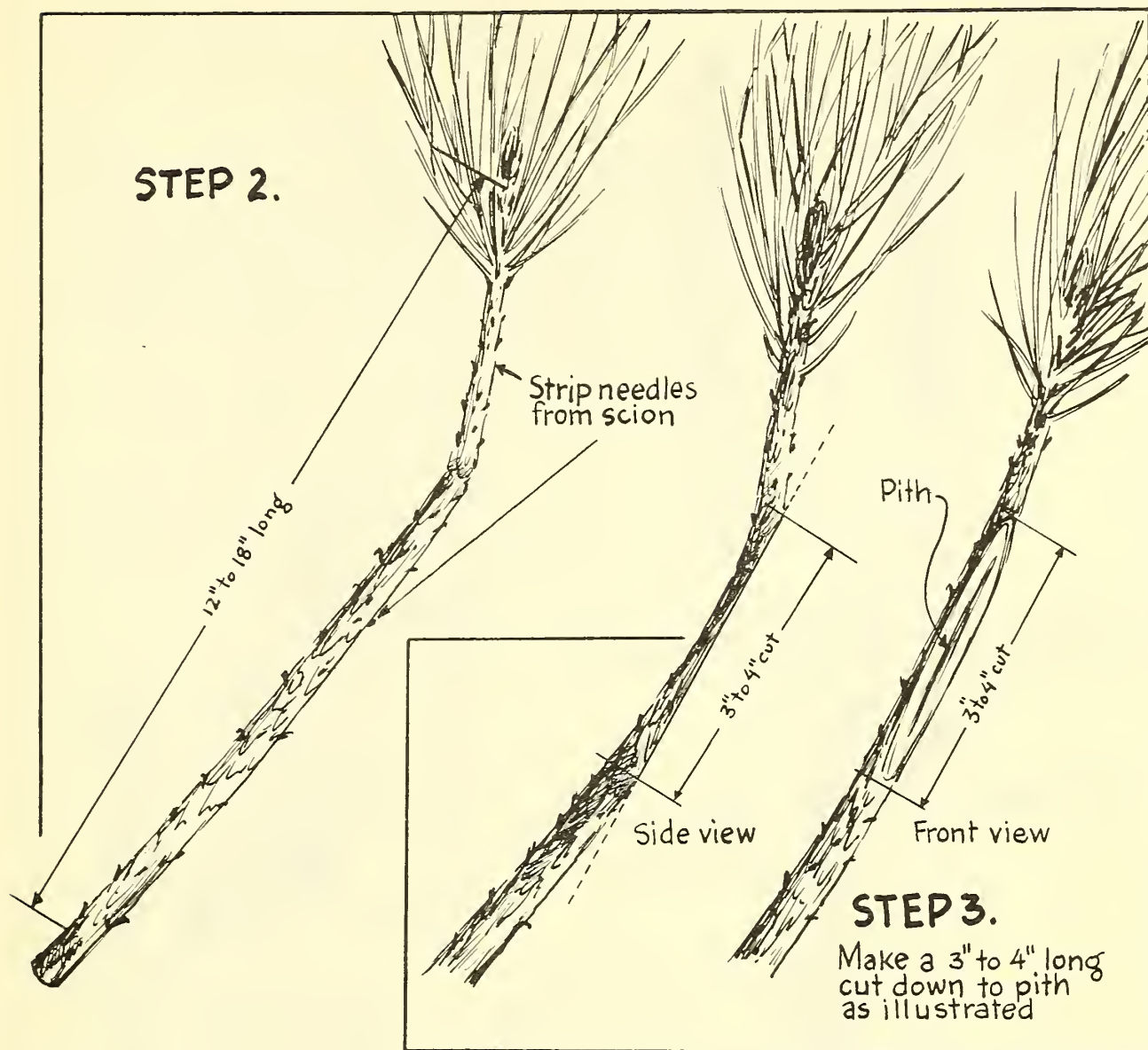
Again it is emphasized that only vigorous plants should be used as stock. When grafting dormant slash pine scions, best results are obtained with the bottle-graft method. This method has proven its value when tested in a greenhouse, in a lathhouse, under partial overhead shade in a forest, and under open field conditions in a 2-year-old plantation. The best time to graft dormant slash pine scions is during January, February, and March.

Bottle grafting is especially well suited for field grafting, because no sweat boxes are necessary for this type of graft. Direct field grafting has several distinct advantages over grafting on potted stock, namely, potted slash pines even when in fairly large pots are not as healthy as plants which have an unlimited space for root development. Also, moving potted plants from one location to another, and outplanting into the field brings about a sudden change in environment which is not without consequence. In addition, grafting directly onto stock in the field will save a great deal of preparatory work which is necessary for grafting on potted stock.

Healthy, 2- to 3-year-old slash pines make the best understock. A 1- to 2-year-old plantation on a good site is ideal for field grafting. It provides uniform stock which is spaced evenly. Before grafting begins, the plants which are to serve as understock can be freed from competing vegetation and fertilized.

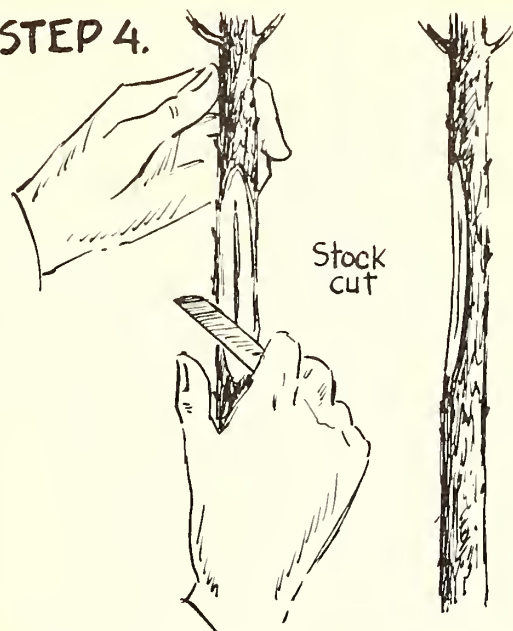
Grafting can be started as soon as active growth of the stock begins. This can easily be determined by the new root activities and by the growth of the buds.





Best results will be obtained if the development of the stock is further advanced than that of the scion. For greenhouse grafting, the stock plants can be forced into active growth by gradually raising the temperature of the house. In a lathhouse, the soil temperature within the pots can be raised by thermostatically controlled lead-sheathed heating cables. For field grafting, where the start of the active growth of the stock cannot be controlled, the development of the scions can be held back by storing them in a refrigerator for a few weeks. If the development of the scion is further advanced than that of the stock, the scion will start to draw water before the stock can supply it.

Collect the scions from the outer edge of the upper half of the crowns. The distal ends of the primary branches make good scion material. Slash pines have several growth periods during one growing season. This frequently results in the formation of bends in the shoots. If possible, make grafting cut through the natural "elbow" as illustrated. Start cut some 3 to 5 inches from bud of scion.

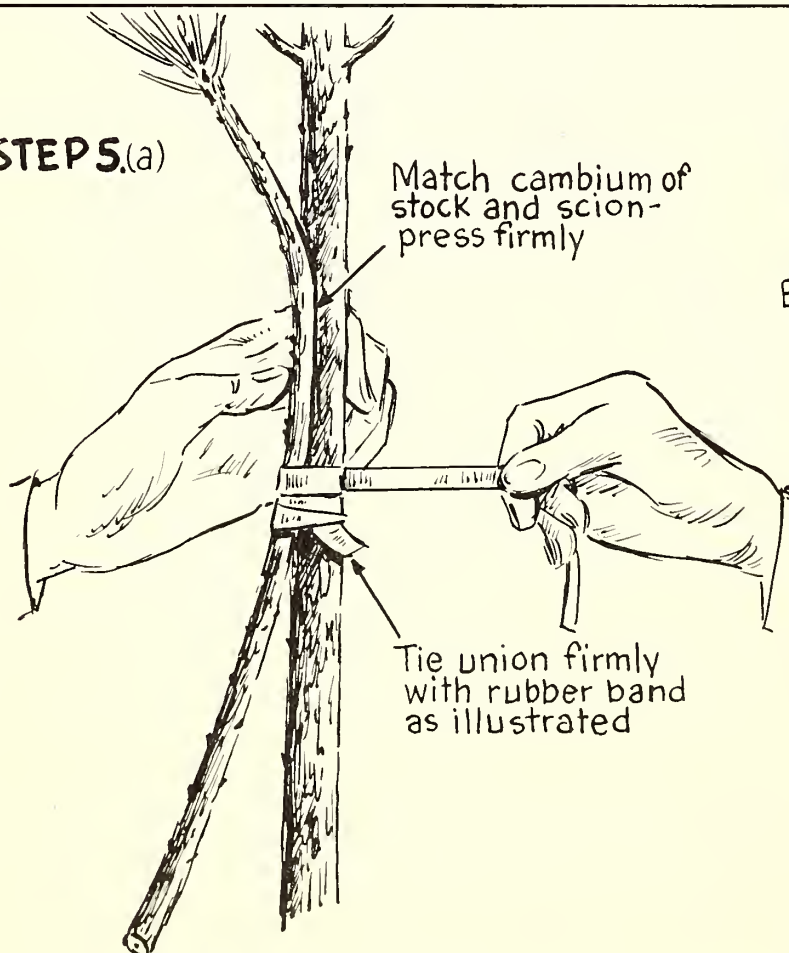
STEP 4.

Make cut on stock same length and depth as cut on scion

Select a section on the stock where the diameter is large enough to support the scion. The part of the stock on which the cut is made has to be free of overgrown wounds, insect attacks, and branch stubs. Prepare cut with a single drawing motion; this will leave a flat, smooth surface. Always keep cuts on scion and stock clean. Match stock and scion promptly to prevent drying out of the surfaces.

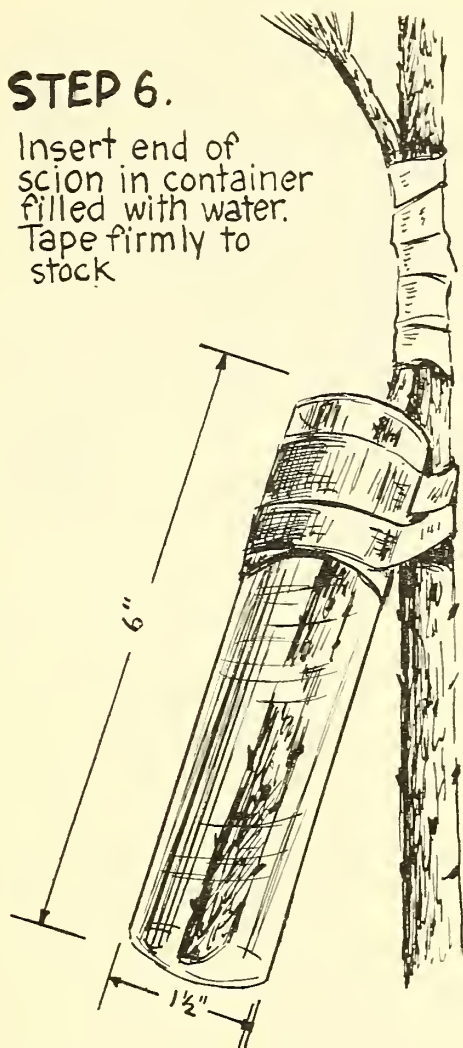
After binding, check alignment of stock and scion.

For grafting directly on stock in the field, place graft on the north or shaded side of the stock where the branches and needles of the plant itself will provide shade.

STEP 5.(a)**STEP 5.(b)**

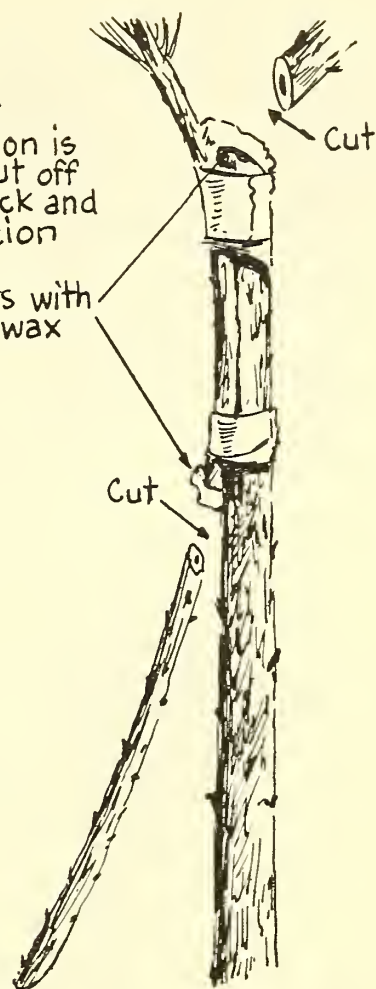
STEP 6.

Insert end of scion in container filled with water. Tape firmly to stock.

**STEP 7.**

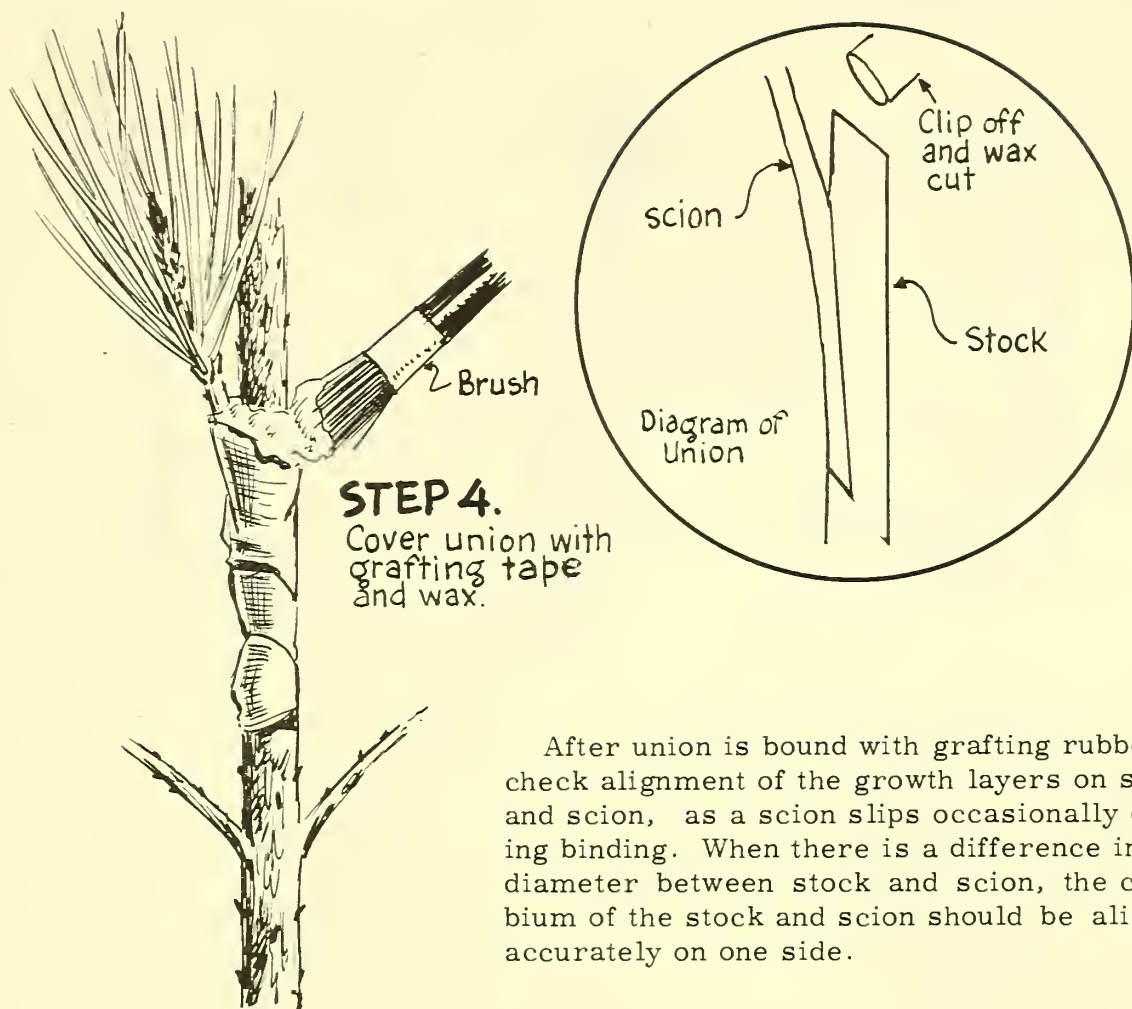
After union is formed, cut off top of stock and end of scion.

Cover cuts with grafting wax.



Keep bottle filled with clean water. If bacterial or algal growth starts to clog the absorbing surface of the scion, remove bottle and wash out all dirt. Before replacing bottle, clip off about one-half inch from the base of the stock.

After the grafts have been made for a period of 2 to 3 weeks, the remainder of the stock branches above the union should be removed gradually. The speed of removal of the excess foliage depends upon the vigor and condition of the individual plants, but in most instances can be completed some 10 to 14 weeks after grafting. Make final cuts as illustrated to allow the grafted scion to become the leader. A loose binding with grafting tape over the newly formed union is desirable to protect it against wind breakage. Also, the grafts should be staked if additional support is needed.



After union is bound with grafting rubbers, check alignment of the growth layers on stock and scion, as a scion slips occasionally during binding. When there is a difference in the diameter between stock and scion, the cambium of the stock and scion should be aligned accurately on one side.

The cutting back of the stock and the rebinding of the union should follow the same pattern as described in page 13.

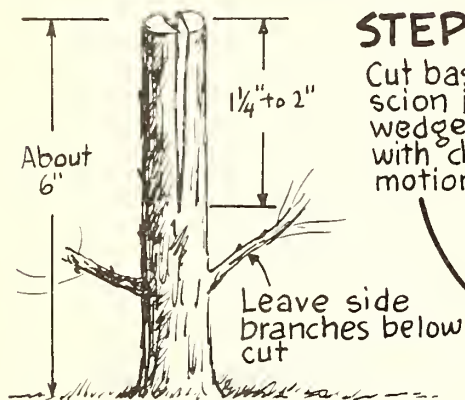
Clippers of the anvil type have been found best in our grafting work. Pruning shears do not leave a clean cut.

The grafting wax can be heated over a portable lamp for field grafting or on a hot plate for greenhouse and lathhouse grafting. Be careful and do not apply wax in too hot a condition. Test before using it. Most wax heating lamps have an open flame, and caution should be taken to avoid starting grass fires.

CLEFT GRAFT

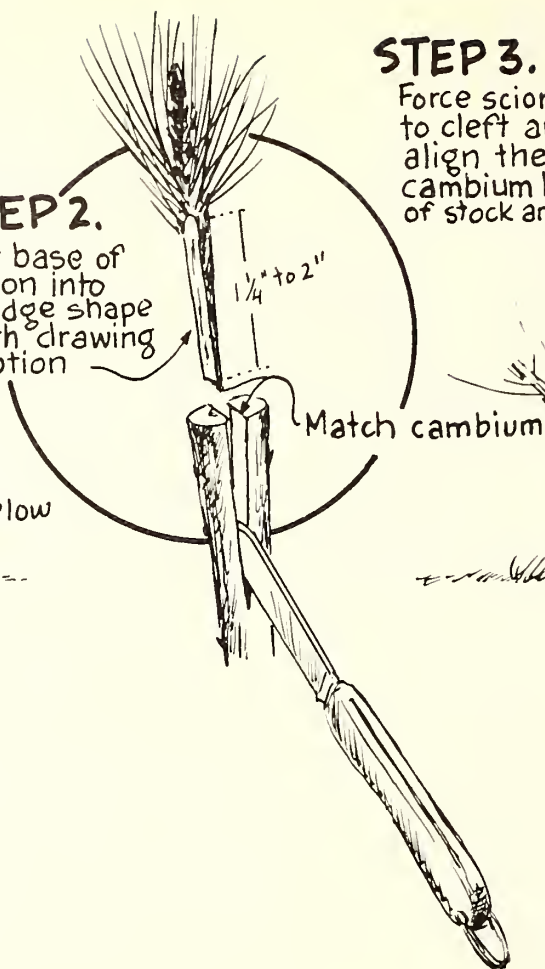
STEP 1.

Make vertical cut with rocking motion of knife to prevent splitting



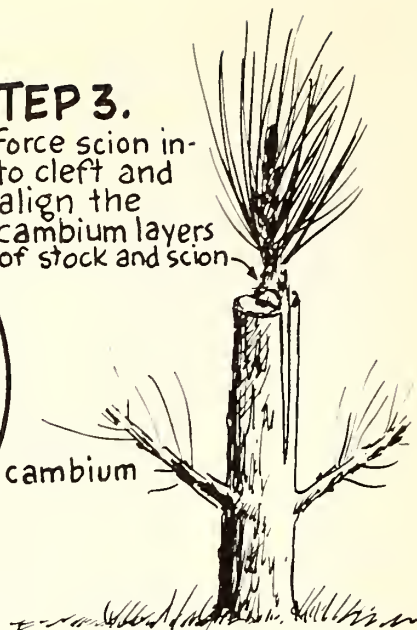
STEP 2.

Cut base of scion into wedge shape with drawing motion



STEP 3.

Force scion into cleft and align the cambium layers of stock and scion



STEP 4.

Bind with grafting rubber-cover with grafting tape and wax entire union

IMPORTANT:
Cover top completely with wax



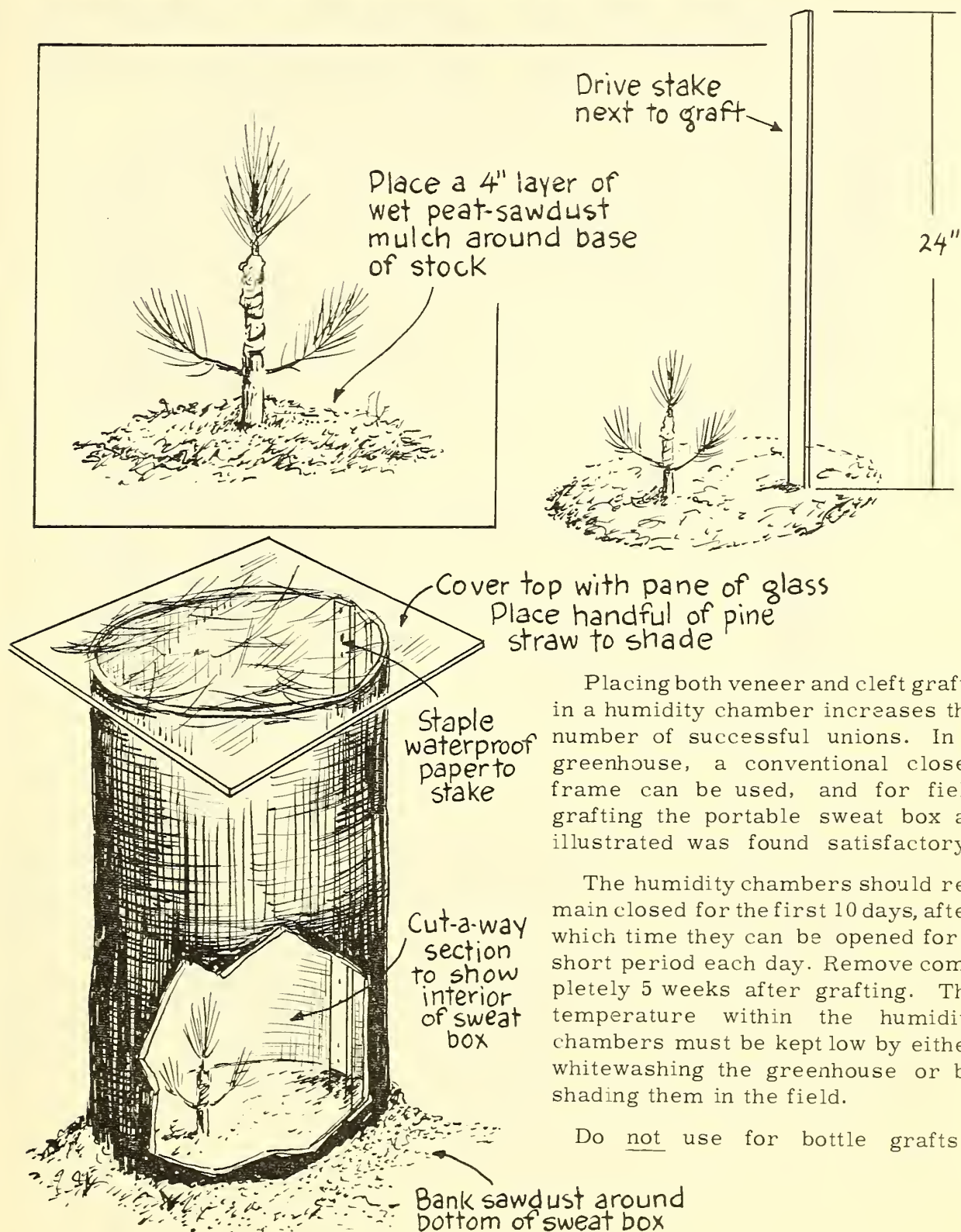
Cleft grafts with lignified stock tissue gave poor results with slash pine. This method should only be attempted in a greenhouse or under a shaded sweat box in the field.

One to several side branches with green foliage should be left below the cut surface. This green foliage will act as a pump in supplying water and nutrients from the roots of the stock to the scion.

This method, however, permits use of stock plants which are not suitable for any of the other types of grafts. Also, no further cutting back of the stock plants is necessary after the graft is made.

Cleft grafts, in general, make very strong unions.

SWEAT BOX FOR FIELD GRAFTING



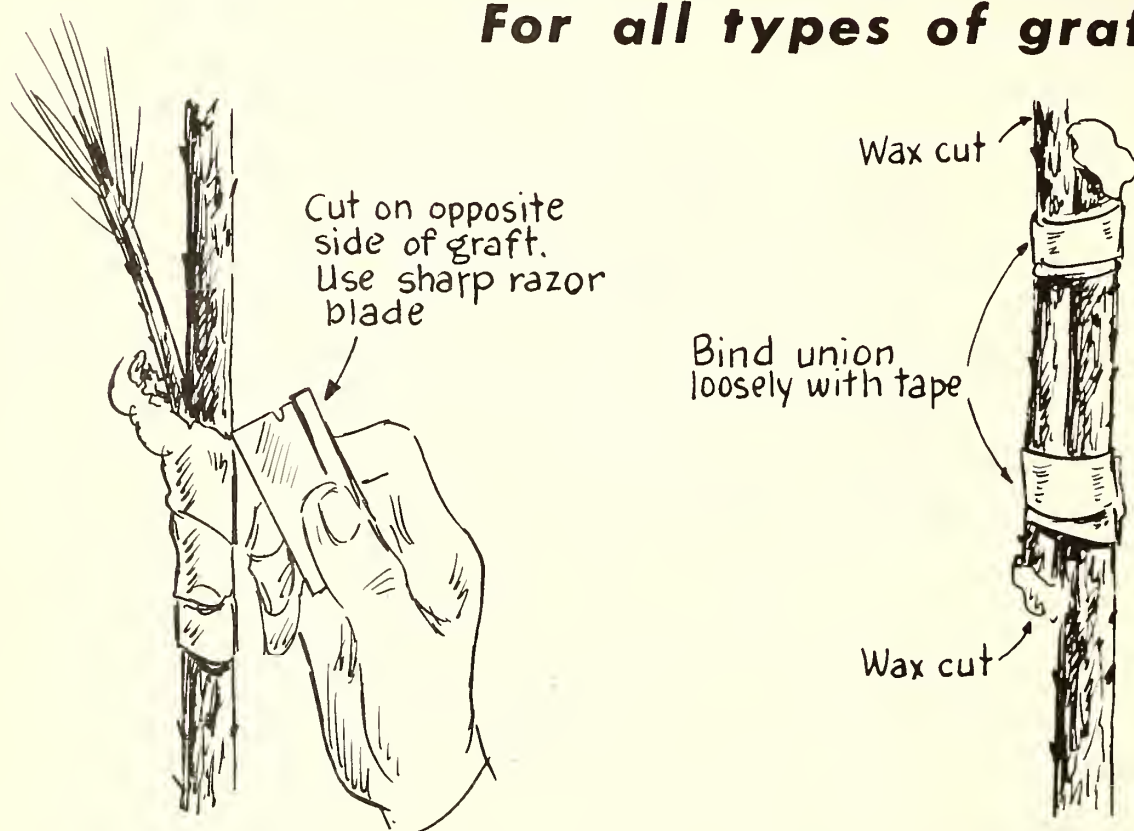
Placing both veneer and cleft grafts in a humidity chamber increases the number of successful unions. In a greenhouse, a conventional closed frame can be used, and for field grafting the portable sweat box as illustrated was found satisfactory.

The humidity chambers should remain closed for the first 10 days, after which time they can be opened for a short period each day. Remove completely 5 weeks after grafting. The temperature within the humidity chambers must be kept low by either whitewashing the greenhouse or by shading them in the field.

Do not use for bottle grafts.

HOW TO REMOVE GRAFTING RUBBER AND TAPE AFTER UNION IS COMPLETED

For all types of grafts

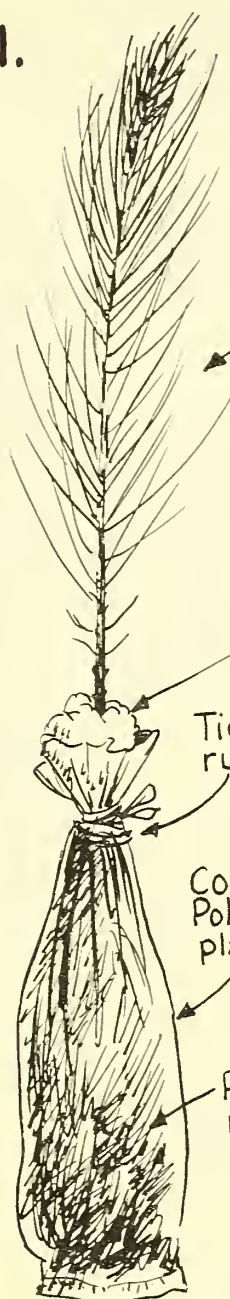


The unions should be watched carefully for signs of strangulation by the binding. After the union has formed, the binding is removed by cutting it on the opposite side of the graft with a sharp razor blade as illustrated. The cutting edge should be wiped clean with alcohol frequently to remove the grafting wax.

The union should be bound loosely with tape to strengthen it against wind breakage. When the final cut is made on the stock, care should be exercised to prevent the breaking loose of the newly formed callus tissue. The final cut(s) should have a slanted surface. Use very sharp clippers. Grafting wax should be applied to these cuts to prevent drying out and checking of the wound.

INARCHING SEEDLING INTO MATURE TREE

STEP 1.



STEP 2.



Seedling

Use cotton to prevent strangulation

Tie with rubber band

Cover with Polyethylene plastic bag

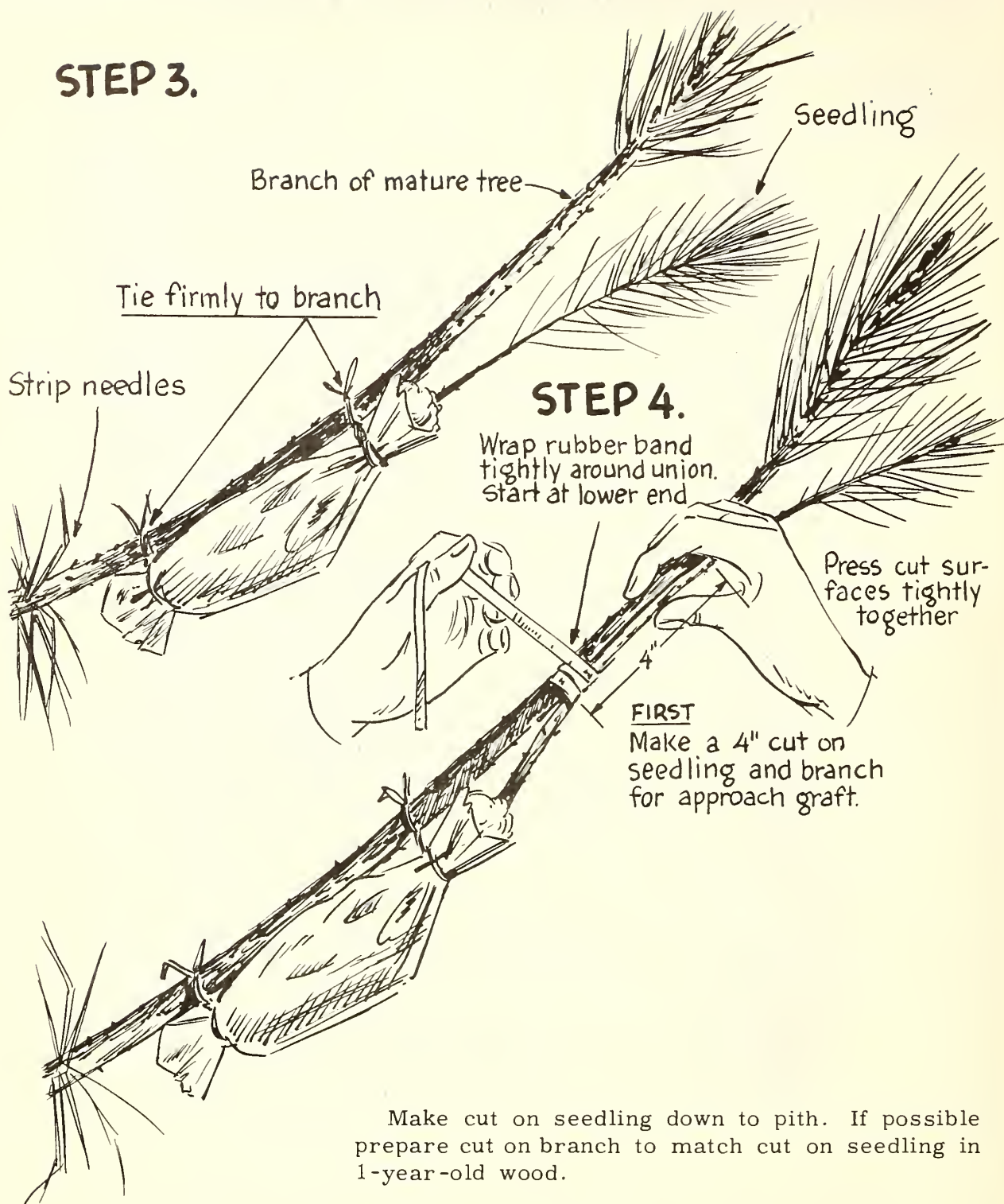
Pack moist peat moss around roots

Cover with kraft paper bag to prevent heating of root system

Leave enough cord to tie to branch of mature tree.

Seedlings with bare root systems have been successfully grafted into the upper and lower portions in crowns of mature slash pines. Grafting should be done during February, March, or April.

STEP 3.



Make cut on seedling down to pith. If possible prepare cut on branch to match cut on seedling in 1-year-old wood.

With the method illustrated, the stresses between the graft partners at the union are negligible because the entire graft can swing freely with the wind.

STEP 5.

After union is tied together with grafting rubber, cover over with grafting tape

WAX ENTIRE UNION

Be sure that top and bottom is completely sealed

STEP 6.

After union is formed, clip off branch at end of union

Clip off root system of seedling and remove bag

Wax

STEP 7.

Place loose binding at each end of union to strengthen against wind breakage

Wax

The binding should be removed after 10 to 14 weeks to ensure against strangulation, using the method as illustrated on page 18. At this time the end of the branch and the root system of the seedlings are cut off.



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GENERAL HINTS

All equipment used in vegetative propagation must be in excellent condition. Success often depends upon the condition of the knives and clippers. Keep these tools sharp and clean at all times.

The necessary equipment for grafting can be ordered from commercial nursery supply houses.

Various safety precautions are necessary. All work with sharp, pointed implements is hazardous, especially when done in the crowns of trees. The following hints should be helpful:

Do not place the grafting knife with the sharp edge facing upward.

Always hold hands in a position where a slip of the knife can not inflict an injury (see page 12).

When working in the tops of trees, use a safety belt or safety saddle.

Shading the newly established grafts will be beneficial. Potted plants can be placed under the partial overhead shade of a forest, or under a lath-house. In field grafting, partial shade can be provided by putting palmetto fronds around the graft, or by placing a sack over a temporary post and slanting it to shade the scion during the hottest part of the day.

